

Food Deserts, Food Hubs, and Farmers Markets in Arizona
An Analysis of Proximity and Potential for Increasing Food Access

by

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ABSTRACT

Food deserts are defined as regions with low average income, low accessibility to grocery stores, and high adverse health outcomes. Food deserts have thus become an important area of public health research, and many actions are being taken across the country to "solve" the variety of problems food deserts represent. Despite the many solutions promoted to improve food security, healthy food access, and health outcomes among individuals living in food desert areas, not all activities have been critically assessed for their potential for sustained impact. Further, little research has been conducted in the state of Arizona regarding food-related 'assets' available to employ in solutions to food desert problems. This analysis gives a glimpse into the complex nature of food deserts, which are impacted by a variety of factors, from economics to public policy to culture. It further provides a current assessment of available assets for potential use in ameliorating the negative impacts of food deserts on Arizona citizens. A graphical asset mapping analysis offers specific consideration of farmers markets and food hubs to possibly aid food deserts in the state.

DEDICATION

Thank you to my family for always loving me and helping me achieve my goals. Thank you to Mr. Dole for first sparking my interest in the environment and showing me that I can make the world a better place. Thank you to Ms. Sarager for teaching me to be grateful for what I have and to strive to be kinder to others. Thank you to Mr. Weeks for always supporting me and preparing me for the challenges of college. Thank you to Dr. Kashiwagi for showing me that we are all just a product of our environment and our decisions, making me more grateful for the people that surround me. Thank you to Dr. Robert for being my greatest mentor and pushing me to do better.

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CHAPTER 1

INTRODUCTION

Statement of the Problem

According to 2013 statistics¹ from the United States Department of Agriculture, food insecurity is a problem that affects 14.3 percent of all households. This means that 17.5 million US households suffer from some level of uncertainty when it comes to accessing and acquiring needed food, due to insufficiencies in money or other resources. Of these households, 39.2 percent – or 6.8 million households – have very low food security.² These values are higher in certain demographic groups. For example, 19.5 percent of households with children suffer from food insecurity; rates range from 23.1 percent in households with children headed by a single man to 34.4 percent in households with children headed by a single woman. The statistics for food insecurity are also higher in some racial groups, specifically Hispanic and non-Hispanic Black households. The food insecurity levels are at 23.7 percent and 26.1 percent, respectfully. Lastly, there is a marked increase in the amount of food security in low-income households, with a rate of 34.8 percent in households with incomes below the poverty line.³

¹ USDA ERS - Food Security in the U.S.: Key Statistics & Graphics. (2015, January 12). Retrieved May 5, 2015, from <http://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx>

² According to the USDA, in households with very low food security, “normal eating patterns of one or more household members were disrupted and food intake was reduced at times during the year because they had insufficient money or other resources for food.”

³ According to the USDA, in households with very low food security, “normal eating patterns of one or more household members were disrupted and food intake was reduced at times during the year because they had insufficient money or other resources for food.”

These statistics, although staggering, are not entirely surprising. The influences on food insecurity by gender⁴, race⁵, and income⁶ have long been documented, but these problems and indicators continue to exist through time. Work has been done to identify certain regions, dubbed “food deserts,” where low access to fresh food and low average household incomes combine to create the conditions for food insecurity. In fact, these “food deserts” have been shown to contain nearly 23 million people across the United States.⁷ Now, action must be taken to target those areas not only in search of causes for this inequity in food distribution and access, but to develop models in which this trend of food insecurity can be reversed.

Background

Food deserts are defined by the United States Department of Agriculture (USDA) as “urban neighborhoods and rural towns without ready access to fresh, healthy, and affordable food”.^{8,9} To be considered a food desert in the United States, the area must meet two criteria based on the

⁴ Moss, N. E. (2002). Gender equity and socioeconomic inequality: a framework for the patterning of women's health. *Social science & medicine*, 54(5), 649-661.

⁵ Shavers, V. L., & Shavers, B. S. (2006). Racism and health inequity among Americans. *Journal of the National Medical Association*, 98(3), 386-396.

⁶ Baker EA, Schootman M, Barnidge E, Kelly C. The role of race and poverty in access to foods that enable individuals to adhere to dietary guidelines. *Prev Chronic Dis* 2006;3(3).

⁷ Economic Research Service. USDA. Access to affordable and nutritious food: measuring and understanding food deserts and their consequences. 2009. Available at: http://www.ers.usda.gov/media/242675/ap036_1_.pdf.

⁸ Food Deserts. (n.d.). Retrieved October 16, 2014, from <http://apps.ams.usda.gov/fooddeserts/fooddeserts.aspx>

⁹ While these neighborhoods lack access to fresh and healthy food, they often do not lack fast food options and convenience stores. Alviola, P. A., Nayga, R. M., Thomsen, M. R., & Wang, Z. (2013). Determinants of food deserts. *American Journal of Agricultural Economics*, 95(5), 1259-1265.

most recent United States Federal Census. First, the poverty rate must be greater than or equal to twenty percent, or the median family income in the neighborhood must be “at or below 80 percent of the area median family income.” Second, “at least 500 persons and/or at least 33% of the census tract's population” must live more than ten miles in a rural community or one mile in an urban community from “a supermarket or large grocery store.”¹⁰ These definitions present a socioeconomic classification of food deserts within the United States, thereby implying a connection between poverty and lack of fresh and/or nutritious food. Understanding the definition of a food desert allows for a better grasp of the factors involved in its characterization.

For instance, food deserts are seen as problems because they have been shown to be important indicators of a higher percentage of health problems among those living in the area; there tends to be a spike in adverse health outcomes in these regions when compared to other regions not defined as food deserts.¹¹ Thereby, the existence of food deserts may lead to, or may be an indication of, social disparities and inequality in terms of both food access and health outcomes.¹² There is research to suggest that the characteristics that define a food desert make it unique in terms of health outcomes from other areas, with a suggestion that income levels and food access have created a divide between communities wherein those communities situated

¹⁰ Food Deserts. (n.d.). Retrieved October 16, 2014, from <http://apps.ams.usda.gov/fooddeserts/fooddeserts.aspx>

¹¹ Gordon, C., Purciel-Hill, M., Ghai, N. R., Kaufman, L., Graham, R., & Van Wye, G. (2011). Measuring food deserts in New York City's low-income neighborhoods. *Health & place*, 17(2), 696-700.

¹² Beaulac, J., Kristjansson, E., & Cummins, S. (2009). Peer Reviewed: A Systematic Review of Food Deserts, 1966-2007. *Preventing chronic disease*, 6(3).

within food deserts are likely to have adverse health outcomes.^{13,14,15} This is one of many reasons that food deserts are of interest to those who are trying to propose solutions.¹⁶

One of the reasons that a food desert is so closely related to health outcomes is because access to fresh and healthy food has been shown to be correlated to a community's overall health.¹⁷ For example, distance from a grocery store is inversely related to the quality of food that a person eats.¹⁸ People in communities with less access to fresh and healthy produce are more likely to report food insecurity, or the inability "to obtain enough food for an active and healthy life,"¹⁹ and are less likely to have balanced diets in accordance with the Dietary Guideline²⁰ recommended by the United States Department of Disease Prevention and Health Promotion. This is an issue because markets "that stock reasonably priced nutritious foods are nearly absent

¹³ Cummins S. Neighbourhood food environment and diet: time for improved conceptual models? *Prev Med* 2007;44(3):196-7.

¹⁴ Wrigley N. "Food deserts" in British cities: policy context and research priorities. *Urban Stud* 2002;39:2029- 40.

¹⁵ Zenk SN, Schulz AJ, Israel BA, James SA, Bao S, Wilson ML. Neighborhood racial composition, neighborhood poverty, and supermarket accessibility in metropolitan Detroit. *Am J Public Health* 2005;95(4):660-7.

¹⁶ Schneider, P. (2012, -07-11). Food deserts: Bringing fresh produce to low-income neighborhoods is the first step toward a citywide food Policy. *The Capital Times*, pp. 18.

¹⁷ This paper suggests an increase in obesity and morbidity in regions with low food access. Specifically, it relates the exponential emergence of childhood obesity in these regions, when compared to other regions. Layte, R. (2011). Creating a health promoting environment: The role of food access. *Quarterly Economic Commentary*, , 1-3. Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/867667106?accountid=4485>

¹⁸ This paper shows that as the distance from a grocery store decreases, the quality of the food consumes increases linearly. Layte, R. (2011). Creating a health promoting environment: The role of food access. *Quarterly Economic Commentary*, , 1-3. Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/867667106?accountid=4485>

¹⁹ Mayer, V. L., Hillier, A., Bachhuber, M. A., & Long, J. A. (2014). Food Insecurity, Neighborhood Food Access, and Food Assistance in Philadelphia. *Journal of Urban Health*, 91(6), 1087-1097.

²⁰ Dietary Guidelines for Americans, 2015. (n.d.). Retrieved April 7, 2015, from <http://www.health.gov/dietaryguidelines/2015.asp>

or inaccessible to people living in poor communities”²¹ compared to those living in more financially prosperous communities.

In order to decrease the size of food deserts, work must be done to determine how these areas can decrease food insecurity. One way is increasing access to fresh and healthy food through systems that are flexible enough to accommodate the nutritional and financial needs of households in food deserts. Researchers have stressed the need for “alternate” retail food outlets in food deserts.^{22,23} The establishment of farmers markets or food hubs, for example, may be potential solutions that could increase access to nutritious food in underserved regions of the country.

Current Research Deficiencies

Although the idea of food deserts has been around since at least the early 1900’s²⁴, there has been little research trying to determine how methods of food distribution other than grocery stores impact food access in these areas. Research has been done on understanding food deserts

²¹ Anthony Troy Adams, Monika J. Ulrich and Amanda Coleman. *Journal of Applied Social Science*, Vol. 4, No. 2 (September 2010), pp. 58-62

²² Larsen K, Gilliland J. A farmers’ market in a food desert: Evaluating impacts on the price and availability of healthy food. *Health Place*. 2009;15(4):1158-1162. doi: 10.1016/j.healthplace.2009.06.007.

²³ Evans AE, Jennings R, Smiley AW, et al. Introduction of farm stands in low-income communities increases fruit and vegetable among community residents. *Health Place*. 2012;18(5):1137-1143. doi: 10.1016/j.healthplace.2012.04.007.

²⁴ Meldrim, A. J. (1912). *Food Security, Social Entrepreneurship, and Farmers’ Markets in Worcester* (Doctoral dissertation, Worcester Polytechnic Institute).

and their determinants, and some work has been done in understanding the development of and the communities' reactions to certain alternate methods, but little has been done to understand the layout of the proposed resources and how proximity and type of method may serve a role in increasing food access.²⁵ Furthermore, there is a severe underrepresentation in current research of food hubs and their usefulness and proximity to food deserts. This may be partly due to the concept of food hubs being relatively new, as far as it has been defined and tracked by the USDA.^{26,27} However, representation of them is important in further analyzing this method and determining its usefulness. This could, in turn, allow for a better understanding of whether or not more time and money should be put into integrating these programs into food deserts.

One way to examine the types of tools and resources a community might leverage to impact food insecurity is through creation of asset maps. However, few asset maps show the layout of food distribution sites in a region with food deserts. Such maps are important in not only understanding the resources available to people in food deserts, but in serving as the first step in further analysis and development of food distribution. For instance, this information, when coupled with financial and medical statistics, can potentially reflect the success of certain programs or distribution sites in reaching people and improving health in food deserts, i.e., the information will be able to track the impact of different interventions. As such, this information

²⁵ Gatrell, J. D., Reid, N., & Ross, P. (2011). Local food systems, deserts, and maps: the spatial dynamics and policy implications of food geography. *Applied Geography*, 31(4), 1195-1196.

²⁶ Dahlberg, K. A. (1995). Report and Recommendations on the Philadelphia, Pennsylvania Food System. Unpublished report). Kalamazoo: Department of Political Science, Western Michigan University.

²⁷ Doherty, K. (1996). What a Difference a Year Makes. *Electronic Engineering Times*, (892), 108.

can be used to develop more accessible and successful sites and programs to increase access to fresh and healthy food. Currently, such a map does not exist for either the state of Arizona or the Phoenix metropolitan area.

Purpose

The general purpose of this study was to determine the proximity of food deserts to established food hubs and farmers markets in the state of Arizona using asset map analysis. Census data was collected and asset maps were constructed to gain insight regarding:

1. The percentage of established farmers markets within a 1 mile radius to one or more food deserts.
2. The percentage of established farmers markets within a 10 mile radius to one or more food deserts.
3. The percentage of established food hubs within a 1 mile radius to one or more food deserts.
4. The percentage of established food hubs within a 10 mile radius to one or more food deserts.

Delimitations

This project is part of a larger project to create asset maps of food production sites, food distribution sites and networks, and food deserts throughout Arizona and New Mexico. As part of this larger project, I chose to determine the proximity from farmers markets and food hubs to surrounding food deserts.

As there were very few farmers markets and food hubs outside of the Phoenix metropolitan area, the asset maps presented in this study are focused solely on the Phoenix metropolitan area. Although non-Phoenix Valley food hubs and farmers markets are taken into account when determining the percent of each within a certain proximity to food deserts, areas shown in figures is limited to the Phoenix area so as to present a clearer image of the proximity between the assets mapped.

Limitations

I had planned to interview operators of food hubs to determine both the distribution of food hub products and their individual views of food access, and developed an IRB proposal. However, I was unable to carry out this plan due to time constraints, and so I did not learn about the distribution networks for the food hubs. Instead, I solely used the food hub distribution sites as

part of the network. When a specific street address was not available for the food hub distribution site, I showed the location as the center of the city or zip code in which it is located.

CHAPTER 2

LITERATURE REVIEW

Food Access and Health Outcomes

Health is a complex subject, in that many different aspects²⁸ may influence the health of an individual, a community, or an entire population. These are often the same aspects that may affect food access, a major determinant of health. It has long been shown that nutrition and health are closely linked. Certain patterns of diet are more associated with better “nutritional health” than others, while some diets are more associated with adverse health outcomes.²⁹ Although the essentials of a healthy diet can vary in degree by individual, it is largely supported that they consist, in part, of a low consumption of saturated fat, a low amount of total fat as a percentage of calories, and a high percentage of dietary fibers in an individual’s overall food consumption.³⁰ Thereby, an unhealthy or poor diet would consist of a diet high in fats and simple carbohydrates, and low in dietary fiber.

The latter dietary pattern is more likely to cause adverse health events to occur. Two of the leading causes of such a diet are the convenience of less nutritious food choices and the lack of

²⁸ Ashcroft, R. (2010). Health inequities: Evaluation of two paradigms. *Health & social work*, 35(4), 249-256.

²⁹ Schwerin, H. S., Stanton, J. L., Smith, J. L., Riley, A. M., & Brett, B. E. (1982). Food, eating habits, and health: a further examination of the relationship between food eating patterns and nutritional health. *The American journal of clinical nutrition*, 35(5), 1319-1325.

³⁰ Ferro-Luzzi, A., & Branca, F. (1995). Mediterranean diet, Italian-style: prototype of a healthy diet. *The American journal of clinical nutrition*, 61(6), 1338S-1345S.

access to more nutritious food choices.³¹ For example, it has been shown that the odds of obesity and other indicators of ill-health rise with a greater “ratio of fast-food restaurants and convenience stores to grocery stores and produce vendors near people’s homes”.³² Inversely, the odds of adverse health events decrease as this ratio decreases. Thereby, access to nutritious food is closely associated with health of individuals and communities.

Similarly, being located far from a grocery store or not being financially stable enough to afford nutritious food consistently can result in a high rate of unfavorable health outcomes throughout the community. It is important to note that income and other financially constraining factors are directly correlated with food security, where those with decreased access to food due to their financial position were more likely to suffer from compromised health.³³

Food Access and Income

Studies show that low-income neighborhoods tend to have higher incidence rates of obesity, cardiovascular disease, and diabetes.³⁴ This could partially be due to the proven lack of

³¹ Daniel Block, What fills the gaps in food deserts? Mapping independent groceries, food stamp card utilization and chain fast-food restaurants in the Chicago area, *Appetite*, Volume 47, Issue 3, November 2006, Page 386, ISSN 0195-6663, <http://dx.doi.org/10.1016/j.appet.2006.08.012>.

(<http://www.sciencedirect.com/science/article/pii/S0195666306005393>)

³² Spence, J. C., Cutumisu, N., Edwards, J., Raine, K. D., & Smoyer-Tomic, K. (2009). Relation between local food environments and obesity among adults. *BMC Public Health*, 9(1), 192.

³³ Olson, C. M. (1999). Nutrition and health outcomes associated with food insecurity and hunger. *The Journal of Nutrition*, 129(2), 521S-524S.

³⁴ Gordon, C., Purciel-Hill, M., Ghai, N. R., Kaufman, L., Graham, R., & Van Wye, G. (2011). Measuring food deserts in New York City's low-income neighborhoods. *Health & place*, 17(2), 696-700.

accessibility to fresh and healthy food within low-income communities.^{35,36,37} It has been shown that this is true among those people with existing health conditions as well, such as with attempting to buy nutritional food for a diabetic.³⁸ It is important to look at income separately from food access and understand the impact that it has on a community's health, as not all adverse health outcomes in low-income communities are related to food access. For instance, factors such as less-than-ideal urban planning³⁹, racial/ethnic makeup of a neighborhood^{40,41,42},

³⁵ Baker EA, Schootman M, Barnidge E, Kelly C. The role of race and poverty in access to foods that enable individuals to adhere to dietary guidelines. *Prev Chronic Dis* 2006;3(3).
http://www.cdc.gov/pcd/issues/2006/jul/05_0217.htm. Accessed February 10, 2009.

³⁶ Jetter KM, Cassady DL. The availability and cost of healthier food alternatives. *Am J Prev Med* 2006;30(1):38-44.

³⁷ Glanz K, Sallis JF, Saelens BE, Frank LD. Nutrition Environment Measures Survey in stores (NEMSS): development and validation. *Am J Prev Med* 2007;32(4):282-9.

³⁸ This paper claims that it is easier to buy healthy and appropriate food for diabetics in places with a higher average income than in low-income neighborhoods. Horowitz CR, Colson KA, Hebert PL, Lancaster K. Barriers to buying healthy foods for people with diabetes: evidence of environmental disparities. *Am J Public Health* 2004;94(9):1549-54.

³⁹ This paper asserts that people that "minority and low-income persons have consistently been found to live in less safe and more disorderly neighborhoods" than middle- and high-income persons, and that "the spatial distribution and perceived safety of physically active spaces contributes to health disparities." A suggestion is made that urban planning may contribute to a decrease in the inequality of health outcomes between neighborhoods of different average incomes. Northridge, M. E., & Freeman, L. (2011). Urban planning and health equity. *Journal of Urban Health*, 88(3), 582-597.

⁴⁰ Moore, L. V., & Diez Roux, A. V. (2006). Associations of Neighborhood Characteristics With the Location and Type of Food Stores. *American Journal of Public Health*, 96(2), 325-331. doi:10.2105/AJPH.2004.058040

⁴¹ Zenk, S. N., Schulz, A. J., Israel, B. A., James, S. A., Bao, S., & Wilson, M. L. (2005). Neighborhood Racial Composition, Neighborhood Poverty, and the Spatial Accessibility of Supermarkets in Metropolitan Detroit. *American Journal of Public Health*, 95(4), 660-667. doi:10.2105/AJPH.2004.042150

⁴² Daniel Block, What fills the gaps in food deserts? Mapping independent groceries, food stamp card utilization and chain fast-food restaurants in the Chicago area, *Appetite*, Volume 47, Issue 3, November 2006, Page 386, ISSN 0195-6663, <http://dx.doi.org/10.1016/j.appet.2006.08.012>.

(<http://www.sciencedirect.com/science/article/pii/S0195666306005393>)

and a lack of transportation^{43,44,45} should also be considered. However, given the strong link between household food insecurity and financial insecurity⁴⁶, and given that many of these other factors have links to income⁴⁷, it is clear that income, food access, and health are intimately related.

Take, for example, the effect of the financial crisis during the 2006-2010 period on the increase in the number of people at risk of being hungry, which resulted in an additional greater than 457 million people⁴⁸ with severe food insecurity around the world. Studies have shown the food consumption score (FCS), which takes into account the frequency and diversity of diet and is closely positively correlated with nutritious value of food, decreased with the increase in food

⁴³ Statistics suggest that while a person with lower income spends a greater percentage of his or her income on transportation than other people with middle and higher income, the amount that he or she spends is still relatively lower. This suggests that those with lower incomes have less access to transportation that may be used to go to grocery stores or other distribution sites for fresh food. U.S. Bureau of Labor Statistics, Consumer Expenditures in 2009, News Release, USDL-10-1390, October 2010. See also .

⁴⁴ This paper asserts that a higher income would allow for people to invest in a car, or other transportation that is more personalized than public transport. It goes on to suggest that having a car available makes it easier for people to access grocery stores in their area. Layte, R. (2011). Creating a health promoting environment: The role of food access. *Quarterly Economic Commentary*, , 1-3. Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/867667106?accountid=4485>

⁴⁵ This paper claims that food access problems in Adelaide, Australia were less linked to geographical distance between the houses and grocery stores, and more correlated with the social and financial welfare of households, which included access to private transportation. Coveney, J., & O' Dwyer, L. A. (2009). Effects of mobility and location on food access. *Health & place*, 15(1), 45-55.

⁴⁶ Tarasuk, V. S. (2001). Household food insecurity with hunger is associated with women's food intakes, health and household circumstances. *The Journal of nutrition*, 131(10), 2670-2676.

⁴⁷ Smith, J. P. (1999). Healthy Bodies and Thick Wallets: The Dual Relation Between Health and Economic Status. *The Journal of Economic Perspectives : A Journal of the American Economic Association*, 13(2), 144-166.

⁴⁸ Brinkman, H. J., de Pee, S., Sanogo, I., Subran, L., & Bloem, M. W. (2010). High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *The Journal of nutrition*, 140(1), 153S-161S.

prices during this time.⁴⁹ Financial security has been shown to be related not only to food access, but quality of diet; thereby, household and population incomes are linked to the health of individuals and communities.

Food Deserts

The idea that food deserts are negative indicators of quality of life is a well rooted belief, but an analysis of the various factors that affect the classification of food deserts and health outcomes within a region would provide a clearer picture of what type of aid a community needs and what might be helpful to do going forward. Of course, there is a strong correlation between food distribution, food deserts, and negative health outcomes⁵⁰; but there are most probably other factors at play, such as financial implications for grocery stores⁵¹; access to transportation⁵²;

⁴⁹ Brinkman, H. J., de Pee, S., Sanogo, I., Subran, L., & Bloem, M. W. (2010). High food prices and the global financial crisis have reduced access to nutritious food and worsened nutritional status and health. *The Journal of nutrition*, 140(1), 153S-161S.

⁵⁰ Gordon, C., Purciel-Hill, M., Ghai, N. R., Kaufman, L., Graham, R., & Van Wye, G. (2011). Measuring food deserts in New York City's low-income neighborhoods. *Health & place*, 17(2), 696-700.

⁵¹ Studies suggest that female shoppers in low-income communities focus on buying discounted items or items that are cheaper than others in their category. As there is decreased profit for the grocery store when customers choose not to buy more expensive items, this could possibly deter the establishment of a grocery store in a low-income neighborhood. Gbadamosi, A. (2009). Cognitive dissonance: The implicit explication in low-income consumers' shopping behaviour for "low-involvement" grocery products. *International Journal of Retail & Distribution Management*, 37(12), 1077-1095.

⁵² U.S. Bureau of Labor Statistics, Consumer Expenditures in 2009, News Release, USDL-10-1390, October 2010.

ethnic and racial diversity⁵³, and levels of education⁵⁴ of the populace. As such, it is important to consider that increased access to fresh food in and of itself may not “solve” the poor health outcomes associated with food deserts. To what extent can the problem of poverty or other systemic problems, such as the problems within the education system, be solved with food? Without consideration of all of the complexity that surrounds food deserts, and other such communities, increased access may only be treating symptoms. Although solving all the problems within a community may be unlikely, understanding the complex nature of food deserts may be the key to creating a significant impact.

Better understanding of food deserts and their correlation with disease, socioeconomic status, culture, and a plethora of other factors will at least allow for the development of solutions to minimize inequalities in distribution from food production sites. These analyses may also help to address other gaps in the understanding of food distribution and food deserts, such as where the definitions refer only to grocery stores as places from which people can get fresh produce. For instance, if there are a number of farmers markets that act as a staple of a community and are open every day, these can provide appropriate access to fresh produce in the community. However, because these are not grocery stores, the region would still be defined as a food desert.

⁵³ This study found that "mixed-race or white high-poverty areas and all African American areas (regardless of income) were less likely than predominantly white higher-income communities to have access to foods that enable individuals to make healthy choices." Baker EA, Schootman M, Barnidge E, Kelly C. The role of race and poverty in access to foods that enable individuals to adhere to dietary guidelines. *Prev Chronic Dis* 2006;3(3).

⁵⁴ The study asserts that health is both directly and indirectly related to level of education, where in, as the level of education increases, health increases. Ross, C. E., & Wu, C. L. (1995). The links between education and health. *American sociological review*, 719-745.

Even so, it is likely that a single solution will not solve such complex problems as financial inequalities, social inequalities, and adverse health outcomes. These are rooted in history and policy and a number of other considerations.

Proposed Solutions for Food Deserts

Researchers, policy makers, and community advocates alike are working to find solutions to the pervasive problem of food deserts, or at least decrease the severity of their impact. These efforts can be categorized into three basic approaches: increasing access to food, providing nutrition education, and increasing available income.

Food Access

Currently, food deserts are defined in terms of both income and distance from grocery stores. Grocery stores are by no means the only source of fresh produce in these communities, but they are the only ones that are accounted for in the calculations. However, there are many alternatives to grocery stores that should be considered when understanding the possible sources of fresh produce for a community. Sometimes, these alternatives already exist within a community⁵⁵, and a better understanding of them may offer opportunities for improved food access.

⁵⁵ In this paper, the authors examine the presence of an “extensive network of small grocery stores in neighborhoods of color,” although there is an absence of larger supermarkets in these same neighborhoods. They argue that it may be more effective to invest in this network, which already exists, rather than solicit supermarkets. Raja, S., Ma, C., & Yadav, P. (2008). Beyond food deserts measuring and mapping racial disparities in neighborhood food environments. *Journal of Planning Education and Research*, 27(4), 469-482.

1. Farms

A farm is defined by the United States Department of Agriculture as “any place from which \$1,000 or more of agricultural products were produced and sold, or normally would have been sold, during the year.”⁵⁶ Farms typically produce fruits, vegetables, animals, meat, or other animal byproducts. These are sold to customers directly or through a middle-man or distributor. Many farms produce only a small amount of product, if any, with at least twenty-five percent of farms having no sales each year, and “at least ... 30 percent” of farms having fewer than ten thousand dollars’ worth of sales.⁵⁷

2. Community Supported Agriculture (CSA)

According to the USDA, Community Supported Agriculture “consists of a community of individuals who pledge support to a farm operation so that the farmland becomes ... the community's farm, with the growers and consumers providing mutual support and sharing the risks and benefits of food production.”⁵⁸ This system allows for there to be share-holders who invest in the CSA and support its upkeep, and receive benefits during the sale of the products. Benefits can be either monetary or as a portion of the crop, animal, or animal byproduct yield. CSAs can sell fruits, vegetables, meat, animal byproducts, and cooked foods, among other

⁵⁶ USDA ERS - Farm Household Well-being: Glossary. (n.d.). Retrieved April 9, 2015, from <http://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/glossary.aspx#farm>

⁵⁷ USDA ERS - Farm Household Well-being: Glossary. (n.d.). Retrieved April 9, 2015, from <http://www.ers.usda.gov/topics/farm-economy/farm-household-well-being/glossary.aspx#farm>

⁵⁸ Defining Community Supported Agriculture. (n.d.). Retrieved April 9, 2015, from <http://www.nal.usda.gov/afsic/pubs/csa/csadef.shtml>

things. Each CSA is its own organization with its own goals, from financial security to supporting the local homeless population. However, all CSAs tend towards creating a local system of agriculture that allows for community involvement.⁵⁹

3. Farmers Market

Farmers markets are “decentralized markets where producers and consumers are directly linked.”⁶⁰ They are common and popular sites wherein farmers advertise and sell their own produce in markets that are usually open to the public, but they are still regulated under the United States Department of Agriculture’s guidelines.⁶¹ Farmers markets are not usually permanent establishments⁶² and so are not always open. However, they usually have a wide variety of fresh produce directly from farms for purchase, and are open to the general public, though they differ in their size and the number of days that they are open.

⁵⁹ Defining Community Supported Agriculture. (n.d.). Retrieved April 9, 2015, from <http://www.nal.usda.gov/afsic/pubs/csa/csadef.shtml>

⁶⁰ Borst, A. (2010). Cooperative food hubs. *Rural Cooperatives*, 77(6), 20-23. Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/822743010?accountid=4495>

⁶¹ Library of Congress. Congressional Research Service. (2006). Farmers' markets. S.I: S.N.

⁶² Library of Congress. Congressional Research Service. (2006). Farmers' markets. S.I: S.N.

Farmers markets are popular across the country and in all income classes.^{63,64,65} One example would be the farmers market at the White Earth Indian Reservation in Minnesota, a location which is reported to have an “epidemic of diabetes” in its population of 10,000, and is classified as a food desert.⁶⁶ The Ojibwe reservation, which is the overall reservation, has at most three grocery stores in its entire area of “more than 1,000 square miles.” The reservation’s “diabetes project” set up a farmers market every Thursday as a way for those living on the reservation to have access to fresh fruit and vegetables in a town that, otherwise, has mostly processed foods in its convenience stores and restaurants described as “a grill and a deep fryer.”⁶⁷ The project aims to provide healthier alternatives for its members and lower the rates of obesity and diabetes within the reservation.

Another example would be the Blue Line Farmers Market, established by the local city government in the city of Compton, California where the nearly 40 percent of the 100,000 residents are obese. The market is open every Wednesday and attracts hundreds, if not

⁶³ This farmers market is located in a food desert where there is a low household income. Farmers market counters white earth 'food desert'. (2013, Aug 30). Native American Times Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1433943147?accountid=4485>

⁶⁴ This farmers market is located in a neighborhood where there is a very high household income. Scarsdale Farmers Market - LocalHarvest. (n.d.). Retrieved April 8, 2015, from <http://www.localharvest.org/scarsdale-farmers-market-M30246>

⁶⁵ Scarsdale, New York has a median household income of \$232,422. (n.d.). Retrieved April 8, 2015, from http://www.bestplaces.net/economy/city/new_york/scarsdale

⁶⁶ Farmers market counters white earth 'food desert'. (2013, Aug 30). Native American Times Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1433943147?accountid=4485>

⁶⁷ Farmers market counters white earth 'food desert'. (2013, Aug 30). Native American Times Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1433943147?accountid=4485>

thousands, of people. It provides fresh vegetables and fruit to an area where the fruit and vegetables available in grocery stores are usually sparse or poor quality.⁶⁸

Similar projects are being developed across the country. In Chicago, Mayor Rahm Emanuel spearheaded the opening of 5 farmers markets throughout the city's poorest neighborhoods and food deserts. This was done in an effort to increase access to fresh produce for the 400,000 people in Chicago had limited access at the time.⁶⁹

4. Food Recovery Program

A food recovery program usually consists of three major players: food banks, food pantries, and soup kitchens. Food banks house food, which they later supply to organizations such as “food pantries, soup kitchens, hunger relief centers, or other food or feeding centers.”⁷⁰ It is rare that food banks directly distribute food to individuals. This is usually the job of food pantries, which provide uncooked food to households that are low-income or unemployed.⁷¹ Soup kitchens take

⁶⁸ Jennings, A. (2013, Sep 15). It's a taste of healthful eating; compton, a 'food desert,' opens blue line farmers' market. Los Angeles Times Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1432370358?accountid=4485>

⁶⁹ Bowean, L. (2012, Apr 27). City to open 5 new farmers markets to help transform food deserts. McClatchy - Tribune Business News Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1009772944?accountid=4485>

⁷⁰ Missouri Department of Health & Senior Services. (n.d.). Retrieved April 9, 2015, from

<http://health.mo.gov/living/wellness/nutrition/foodprograms/foodrecovery/definitionsservices.php>

⁷¹ Missouri Department of Health & Senior Services. (n.d.). Retrieved April 9, 2015, from

<http://health.mo.gov/living/wellness/nutrition/foodprograms/foodrecovery/definitionsservices.php>

the resources from food banks to cook meals in their facilities for poor and homeless individuals. Food recovery programs can be funded by the government, individuals, or both.⁷²

For instance, Judith Cruz, CEO of Treasure Coast Food Bank in Fort Pierce, Florida, established a program to provide families with fresh fruits and vegetables, in an attempt to increase the quality of the food that they eat. The program is attempting to go beyond providing food, and aiding individuals financially and emotionally.⁷³

5. Food Hub

A food hub is defined as ““a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand.””⁷⁴

Food hubs serve as a middleman between farmers and consumers. They gather different types of produce from many farms, repackage it, and sell it to consumers as collection of items. In doing so, “[food hubs] serve as aggregation points through which smaller producers can collectively market to [a] larger [population of] buyers that they would otherwise not have access to.”⁷⁵ The packages of produce are arranged in the distribution center (or “hub”) and are either picked up by

⁷² Missouri Department of Health & Senior Services. (n.d.). Retrieved April 9, 2015, from <http://health.mo.gov/living/wellness/nutrition/foodprograms/foodrecovery/definitionsservices.php>

⁷³ Readling, M. (2012). Food bank adds nutrition education to mission; program stresses healthy eating in area of 'food desert'. The Palm Beach Post (1984), , N.5.

⁷⁴ Matson, J. (2013). The role of food hubs in food supply chains. Journal of Agriculture, Food Systems, and Community Development, 3(4), 1.

⁷⁵ Borst, A. (2010). Cooperative food hubs. Rural Cooperatives, 77(6), 20-23. Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/822743010?accountid=4485>

or delivered to customers. By collecting food from multiple sources, these facilities are able to distribute complete assortments of fresh groceries to consumers, usually based on a membership, subscription, or group service.⁷⁶

6. Mobile Food Market

Mobile Food Markets are similar to food trucks, but sell fresh produce instead of cooked food. These markets are also similar to farmers markets in their attempt to go into communities and neighborhoods. Mobile food markets are in use mostly in neighborhoods with lack of access to fresh produce and with a low average household income. Many have been set up in food deserts, including a very successful one in Memphis, Tennessee.⁷⁷ However, the effectiveness of this system is difficult to determine as there are estimated to be less than 100 established mobile food markets today.⁷⁸

⁷⁶ Borst, A. (2010). Cooperative food hubs. *Rural Cooperatives*, 77(6), 20-23. Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/822743010?accountid=4485>

⁷⁷ Ken Reardon established a bus that sold fresh fruit and vegetables in locations in Memphis, Tennessee where there is low access to grocery stores, focusing on urban areas with large populations. The “Green Machine” made “more than 600 stops,” “attracted more than 15,000 customers,” and “sold more than \$53,000 worth of” produce within its first year. The owners are now investing in a brick-and-mortar grocery store with their earning in order to increase accessibility to fresh produce. They have been approached by groups from “Nashville, Chicago, Washington, D.C., Detroit, and areas in Maryland and California” seeking information on how to operate a food truck. Shaw, C. (2014, Oct). Food desert oasis. *Memphis Flyer* Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1621818561?accountid=4485>

⁷⁸ Zepeda, Lydia, and Anna Reznickova, *Measuring Effects of Mobile Markets on Healthy Food Choices*. Madison, University of Wisconsin, November 2013. Web. <http://dx.doi.org/10.9752/MS142.11-2013>

7. Community Garden

Community gardens are plots of land used to harvest food and raise animals within a neighborhood. Community gardens are usually open to anyone within the community, and set up such that people are given pieces of land on which to grow crops.⁷⁹ There is much encouragement to develop these gardens, and the USDA even provides a guidebook on how to do so.⁸⁰ They are popular in urban communities and are often looked to as ideal for food deserts⁸¹, but community gardens vary drastically in their levels of success and sustainability.⁸²

Nutrition Education

Although increasing food access is important, it has been shown that the construction of new grocery stores, for example, does not necessarily lead to healthier eating practices and better health outcomes.⁸³ In such cases, it may be helpful to also provide nutritional education to

⁷⁹ Corrigan, M. P. (2011). Growing what you eat: Developing community gardens in Baltimore, Maryland. *Applied Geography*, 31(4), 1232-1241.

⁸⁰ Community Garden Guide. (n.d.). Retrieved April 8, 2015, from http://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mipmcot9407.pdf

⁸¹ The City of Frederick Housing Authority in Frederick, Maryland are setting up a community garden within its new housing project, Lucas Village. Torey Repetski, one of the leaders in this project, believes that the presence of a community garden will encourage residents to make more positive food choices and “cut down on grocery bills.” Financial support is seen as important by more than one person involved in this project, as the “average household income is \$22,000.” Repetski adds that the garden will reduce the need for transportation, something that a resident of Lucas Village notes as a deterrent to going to a grocery store outside of the food desert. The garden project is planned to integrate “healthy cooking” and nutritional educational classes into community programming. Gross, D. J. (2013, Sep 05). Community garden to flourish in 'food desert'; housing authority guides effort to supply fresh food. *McClatchy - Tribune Business News* Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1429816284?accountid=4485>

⁸² Schmit, R. (2010, Jul 14). Hit and miss: Community gardens have successes, failures. *McClatchy - Tribune Business News* Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/609075917?accountid=4485>

⁸³ Cummins, S., Flint, E., & Matthews, S. A. (2014). New neighborhood grocery store increased awareness of food access but did not alter dietary habits or obesity. *Health Affairs*, 33(2), 283-91. Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1498231542?accountid=4485>

empower community members to make educated choices regarding their own health. The USDA encourages the use of nutritional programs through a variety of different outreach programs that it heads or supports.⁸⁴ Such programs have already been introduced in various food deserts across the country.⁸⁵ One example, is the “Your Plate” program, an educational program focusing on nutritional choices and cost reduction, established by Judith Cruz, CEO of Treasure Coast Food Bank in Fort Pierce, Florida. The program, “Your Plate,” works with families “to work as a team for healthier living,” creating a sense of community regarding food choices. The program also focuses on examining stressors in the individuals’ lives to determine if their nutritional choices are affected by these.⁸⁶

However, the relative success of these programs varies immensely depending on the resources available. There are many factors to take into consideration, from training of instructors to time constraints to interest among community members to actual implementation by the participants.⁸⁷ It is difficult to predict the success of such programs, but nutritional education is still supported as it is thought to increase the decision-making power of the individual and promote healthy eating behaviors.⁸⁸

⁸⁴ United States.General Accounting Office, & United States. (2004). Nutrition education. Washington, D.C.: U.S. General Accounting Office.

⁸⁵ Gustin, G. (2010). North side grocery aims high; backers bring nutrition to 'food desert,' also offer education, urban farm, hope for renewal. St.Louis Post-Dispatch, , A.1.

⁸⁶ Readling, M. (2012). Food bank adds nutrition education to mission; program stresses healthy eating in area of 'food desert'. The Palm Beach Post (1984), , N.5.

⁸⁷ Mojisola D. Kupolati , Una E. MacIntyre , Gerda J. Gericke , (2014) "School-based nutrition education: features and challenges for success", Nutrition & Food Science, Vol. 44 Iss: 6, pp.520 - 535

⁸⁸ Nutritional education benefits black students (2008). EPM Communications, Inc.

Income

One of the primary reasons behind the disparities between food deserts and other areas is the difference in the average household income. There are two primary ways in which to approach this problem: have more money or spend less money. As for gaining more money when there is very little, if any, there is no more efficient a way than through higher education. An individual's level of education has been shown to be directly related to that person's income⁸⁹ as well as his or her health.⁹⁰ Increasing the average level of education may create a change in the average income of the community, thereby allowing for greater access to resources. As for people unwilling or unable to pursue higher education, classes and workshops about financial literacy and budgeting may be helpful, but the overall effectiveness of these programs is unknown. These types of programs have already been implemented in some food deserts, as with the "Your Plate" program mentioned earlier, where the program that focuses on reducing the need for financial expenditure by the families by providing fruits and vegetables, and by providing basic financial and budgeting lessons to decrease expenditures and increase financial security.⁹¹

However, furthering the reach would be instrumental in increasing savings among the populace and allowing them to make educated choices on where to spend money and how to budget out

⁸⁹ Ross, C. E., & Wu, C. L. (1995). The links between education and health. *American sociological review*, 719-745.

⁹⁰ Fell-Chambers, R. (2014). Adult Education and Health. *International Journal of Lifelong Education*, 33(1), 111-113.

⁹¹ Readling, M. (2012). Food bank adds nutrition education to mission; program stresses healthy eating in area of 'food desert'. *The Palm Beach Post* (1984), , N.5.

their earnings. This could possibly allow for further support of educational programs for children by their community, thereby creating a systemic change. Although it may seem idealistic, increasing education of any kind has been shown to help people deal with and break out of poverty and inequality.⁹²

Focus on Farmers Markets and Food Hubs

Many of the sources that define food deserts do not take into account food distribution organizations other than grocery stores, and thus do not allow for a complete look at how these other organizations play a role currently in and can affect the future of food deserts. Two of these types of organizations are farmers markets and food hubs, which are both described in the previous section. As both of these types of distribution channels are more mobile in their expanse and outreach (i.e., they are able to move their central location or distribution network more freely because they are not tied to sedentary brick and mortar buildings) than traditional grocery stores, it may be beneficial to understand more about their role in food deserts. Additionally, they both offer fresh food to consumers and are already established within the state. Their relatively flexible structures, when compared to grocery stores, would allow for an easily malleable distribution system, which could allow for service to food deserts. Food hubs and farmers markets can establish new locations or distribution sites easily, as they are not fully reliant on stationary buildings, if at all.

⁹² Morrisson, C. (2002). Health, education and poverty reduction. Paris: OECD Publishing.

Since the 1980's, there has been an exponential increase in the number of farmers markets established across the United States.⁹³ However, researchers have found that most consumers visit farmers markets due to the “quality of products offered and the ability to support local community,” not to “fill their grocery needs.”⁹⁴ This suggests that while farmers markets are providing people with fresh produce, they are not currently effective in providing an environment in which the shoppers can buy all necessary produce, thus leading customers to rely at least partially on traditional grocery stores. Understanding the factors that govern a farmers market could allow us to understand why this is, and if it could be used to offer consumers a place to buy all their necessary fresh groceries, if in fact it is found that farmers markets can benefit those within food deserts.

Food hubs are similar to farmers markets in that they provide fresh produce from local farms to consumers. However, they are not as well established and, as such, food hubs tend to face problems in terms of undercapitalization, placement of liability, and an overall lack of capacity for processing, storage, and resources.⁹⁵ Further analysis of the systems that make up a food hub's network of distribution may present a link between the structure of food hubs and the practicality in using them within food deserts. However, although there is already a great

⁹³ Brown, A. (2001). Counting farmers markets. *Geographical Review*, 91(4), 655-674.

⁹⁴ Dodds, R., Holmes, M., Arunsopha, V., Chin, N., Le, T., Maung, S., & Shum, M. (2014). Consumer Choice and Farmers' Markets. *Journal of Agricultural and Environmental Ethics*, 27(3), 397-416.

⁹⁵ Matson, J., Sullins, M., & Cook, C. (2013). The role of food hubs in local food marketing.

literature base for understanding the use of farmers markets in several different regions, there exists a gap in research concerning food hubs overall, and research concerning food hubs as related to food deserts, in particular. Thereby, any assumptions made about their usefulness are just that – assumptions.

Asset Mapping

When trying to determine possible utility of different food distribution systems in relation to food deserts, it is important to ascertain where everything lies, so researchers can better analyze the spatial situation and influences that may exist between these systems and food deserts. This can be done through a method known as “asset mapping,” where an ideological or spatial map is created, and where resources or assets are represented⁹⁶. Asset mapping can be used to take inventory of working resources, such as after a natural disaster⁹⁷. Asset mapping is helpful to not just determine current or past trends, but to make predictions and decisions regarding the future.

For instance, from a public health perspective, asset mapping could be used by public health scientists to determine where active and inactive industrial factories exist in a region of the country in relation to nearby human populations. The scientists could then understand possible lung-health patterns historically, or make educated decisions on where to build new industrial

⁹⁶ Asset Mapping. (1999, January 21). Retrieved October 16, 2014, from <http://extension.missouri.edu/about/fy00-03/assetmapping.htm>

⁹⁷ Norman, J. (2007, Oct 30). Foundation promoting asset mapping. McClatchy - Tribune Business News Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/463761843?accountid=4485>

factories in proximity to human populations. Asset mapping is helpful in looking at the overall picture and the network of connections between different factors, rather than studying each factor independently⁹⁸. As such, they can help to create a more encompassing solution for a set of problems, rather than treating each problem individually.

⁹⁸ van, d. W., & Myburg, J. (2014). Mobile mapping: Optimising total infrastructure asset management. *Civil Engineering : Magazine of the South African Institution of Civil Engineering*, 22(4), 33-36. Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1543047350?accountid=4485>

CHAPTER 3

METHODOLOGY

In this study, I mapped the locations of farmers markets, locations of food hub distribution centers, the distribution networks of food hubs, and the geographical areas of food deserts for further analysis. I did this to determine the extent of the presence of farmers markets and food hubs within Arizonian food deserts. Additionally, I explored the possibility of using farmers markets and food hubs in increasing accessibility to fresh food within Arizona food deserts.

My mapping did not focus on all of the factors covered in the overall project, but instead focused on mapping and finding correlations between food deserts and distribution sites/networks.

Although it would have been possible to include other production and distribution sites in the overall map, as this paper is part of a larger project, I limited my maps and analysis to focus on food deserts, food hubs, and farmers markets in Arizona. Additionally, I did not include transportation systems, socioeconomic statistics, and health statistics for individual census tracts so as to focus more closely on the main goals of this project. My main goals were to find the locations of food deserts, farmers markets, and food hubs in Arizona, and develop an asset map that shows the distribution and proximity of the food deserts and these two types of food distribution systems.

Data Collection

In order to determine the locations of food deserts in Arizona, I conducted a literature review using agricultural census data from the United States Department of Agriculture's (USDA) Food Access Research Atlas data.⁹⁹ This data was downloaded from the official USDA website, and the number for each geographical tract in the state of Arizona was recorded. The data was gathered from the most recent census conducted and included information regarding the income classification (low, middle, or high), distance from a grocery store, and urban/rural classification for each tract, among several other classifications (Table 1).

To determine the location of each farmers market throughout Arizona, I utilized data available through the USDA Agricultural Statistics and recorded the locations of each farmers market (Table 2). To determine the location of each food hub located in Arizona, I used data found through a basic query of "food hub Arizona" through the Google search engine. In addition to an official record of food hubs from the USDA, I also supplemented the list with information from other organizations. Overall, I utilized the USDA Food Hubs Directory, the National Good Food Network, and various blogs made by organizations advertising ways in which to buy local

⁹⁹ Food Access Research Atlas: Download the Data. (n.d.). Retrieved 2015, from <http://www.ers.usda.gov/data-products/food-access-research-atlas/download-the-data.aspx>

food^{100 101 102}. I found that all of the currently functional food hubs I could find were listed between the USDA Food Hubs Directory and the National Good Food Network. Using these resources, I recorded 37 different distribution sites for food hubs (Table 3).

Asset Map Creation

In order to show the distribution and proximity of the food deserts, farmers markets, and food hubs within Arizona, I developed an asset map. An asset map is a geographical map that identifies the locations of resources or assets¹⁰³. In this case, the assets are food deserts, sites of farmers markets and food hubs, and distribution networks of food hubs. In order to create this graphic, I utilized coding through the online version of Geographic Information System (GIS)¹⁰⁴, a computer system that can represent and manipulate spatial and geographical information, called ArcGIS. The program allows for superposition of various maps and locations to create a complete asset map for analysis and modeling, among other uses. Initially, I was working with a mapping team to create an asset map using the data that I had collected. However, due to time restrictions, I began developing the maps myself with the help of online resources from the ESRI

¹⁰⁰ USDA FoodHubs Directory - Agricultural Marketing Service. (n.d.). Retrieved April 8, 2015, from <http://search.ams.usda.gov/foodhubs/>

¹⁰¹ An example of a blog that I visited. The blogs did not include food hubs outside of those listed by the other two resources, so I did not include the others as references here. Grazing Arizona: How Food Hubs Help Local Farmers Grow. (n.d.). Retrieved April 8, 2015, from <http://phoenix.ediblefeast.com/where-shop/grazing-arizona-how-food-hubs-help-local-farmers-grow>

¹⁰² Food Hub Center. (n.d.). Retrieved November 14, 2014, from <http://www.ngfn.org/resources/food-hubs#section-11>

¹⁰³ Asset Mapping. (1999, January 21). Retrieved October 16, 2014, from <http://extension.missouri.edu/about/fy00-03/assetmapping.htm>

¹⁰⁴ Mapping Food Deserts. (2011). Appliance Design, 59(5), 9. Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/876593758?accountid=4485>

organizations and YouTube tutorials. In the graphic I overlaid the food deserts, sites of farmers markets, and sites of food hubs over the geographic expanse of Arizona, providing an easily understandable visual of current circumstances.¹⁰⁵

To determine the extent to which farmers markets do or do not reach food deserts, I created an asset map to represent the locations of farmers markets overlaid by food desert regions (Figure 2). This method gave me quantitative data to determine whether or not farmers markets are currently present in or near food deserts, and to what extent. To be “in or near” a food desert, a farmers market must be within 1 mile of an urban food desert and 10 miles of a rural food desert. To determine the extent to which food hubs do or do not reach food deserts, I also formed an asset map of food hubs, and compared by overlaying the asset map of food deserts and the asset map of the locations of food hub distribution sites (Figure 4).

¹⁰⁵ Smith, R., & Miller, K. (2013). Ecocity Mapping Using GIS: Introducing a Planning Method for Assessing and Improving Neighborhood Vitality. *Progress in community health partnerships: research, education, and action*, 7(1), 95-106.

CHAPTER 4

RESULTS AND DISCUSSION

There are 236 food deserts in the state of Arizona, as determined by the USDA. Of these food deserts, 56 are in rural regions and 180 are in urban areas. In Figure 1, the asset map shows the distribution of food deserts in Arizona, which shows their presence throughout the state.

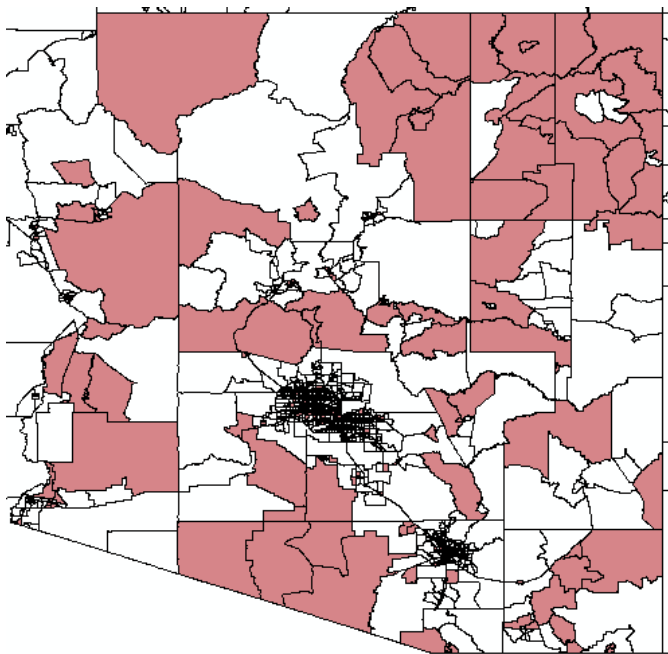


Figure 1. Food Deserts in Arizona. *The map show the census tracts (outlined in black) in Arizona, with red shading for the 236 food deserts and white shading for those tracts not considered food deserts.*

However, there is little evidence of food hubs (except for 1 outlier) and farmers markets outside of the Phoenix metropolitan area. In Figures 2-4, we see that the food hubs and farmers markets are mainly located outside of food deserts, although there are a few within and many near the food deserts.

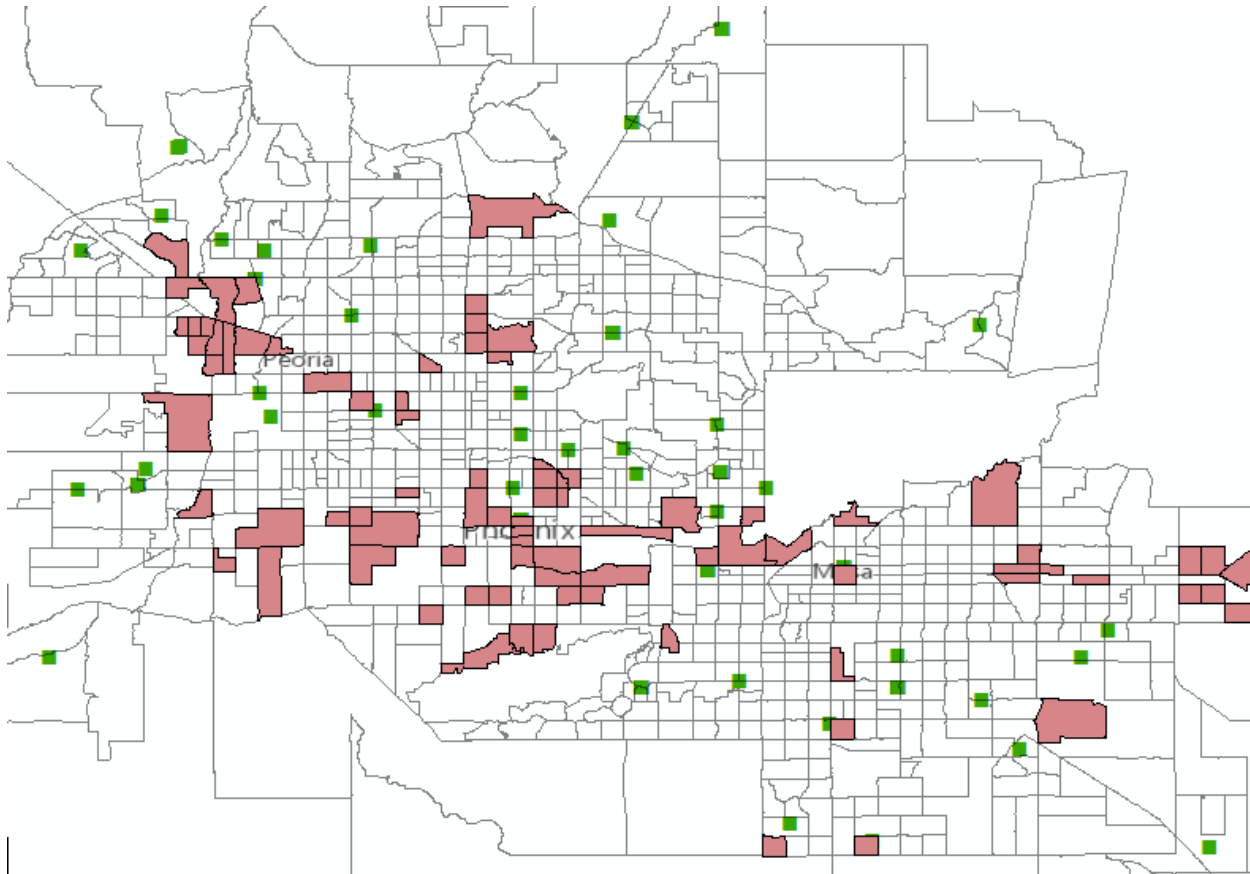


Figure 2. Farmers Markets in the Phoenix Metropolitan Area. *The maps shows the census tracts (outlined in black) within the Phoenix metropolitan area. The red tract areas are food deserts while the white areas are not. The green squares are the location of 47 farmers markets.*

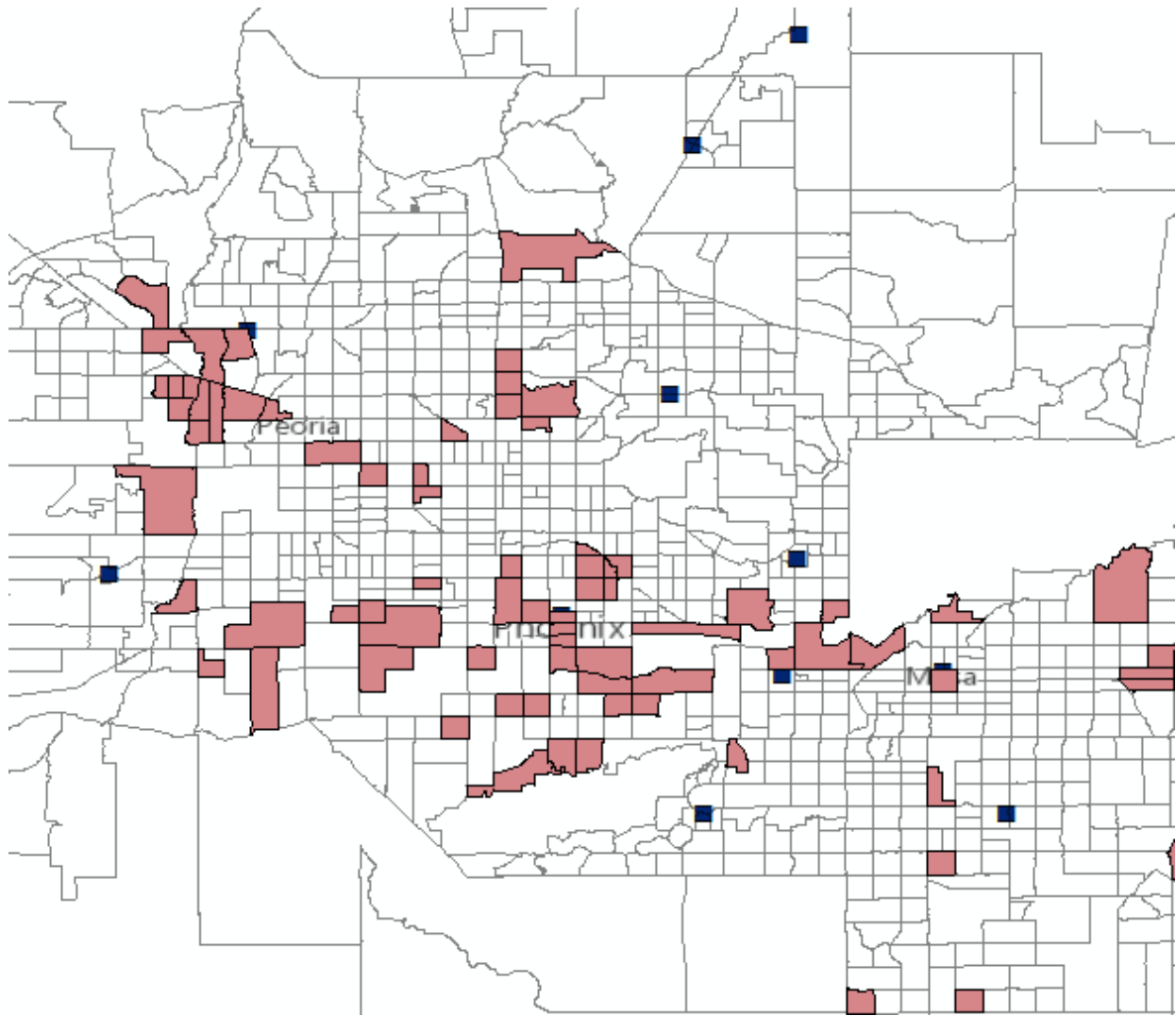


Figure 3. SNAP Approved Farmers Markets in the Phoenix Metropolitan Area. *The map shows the census tracts (outlined in black) within the Phoenix metropolitan area. The red tract areas are food deserts while the white areas are not. The blue squares are the location of 12 SNAP approved farmers markets.*

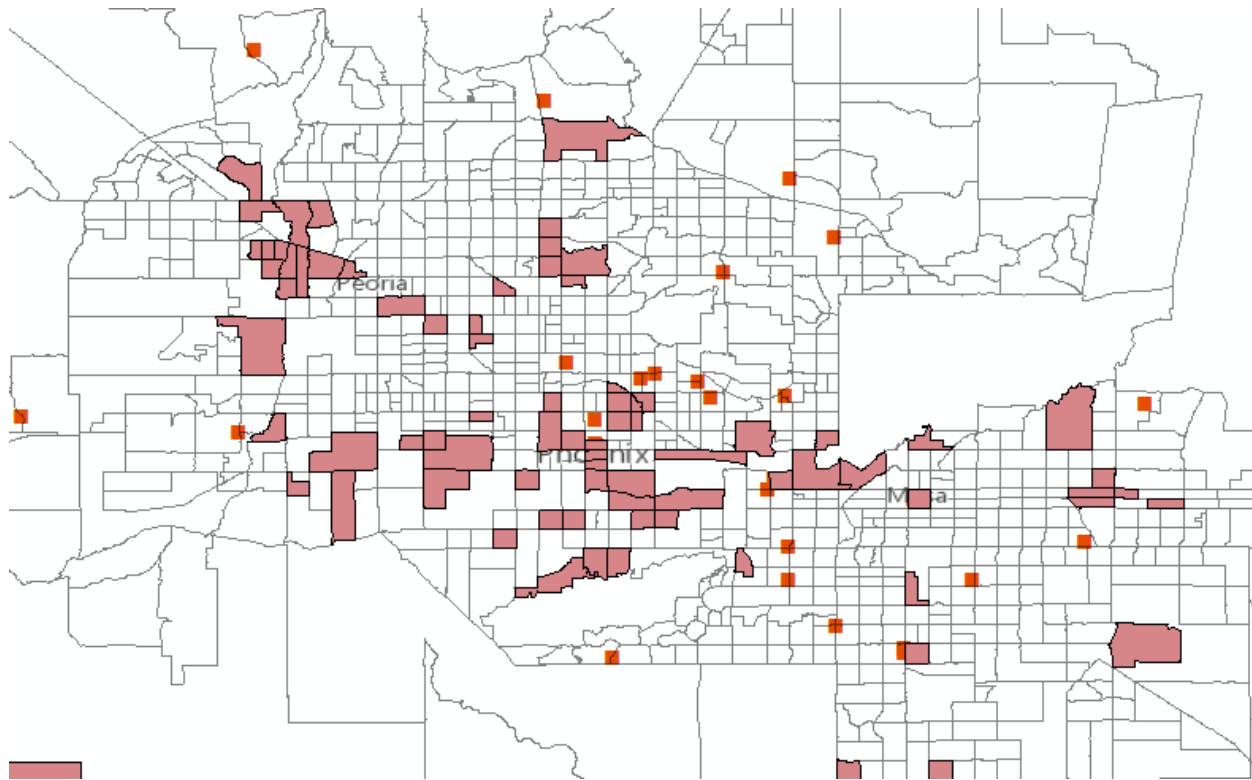


Figure 4. Food Hubs in the Phoenix Metropolitan Area. *The map shows the census tracts (outlined in black) within the Phoenix metropolitan area. The red tract areas are food deserts while the white areas are not. The red squares are the location of 37 food hubs.*

As for the farmers market, analysis of Figure 5 shows that of the 47 farmers markets mapped, 17 were within 1 mile (light orange circle) and 44 were within 10 miles (dark orange circle) of at least one food desert. Again, as these farmers markets are located within largely urban areas, only 17 (36%) of the farmers markets can be seen as accessible for an urban population, using the definition of a food desert to determine food access parameters. Although transportation may

be necessary to reach the majority of these markets, it is possible to use these established sites to increase access to fresh produce within the surrounding food deserts.

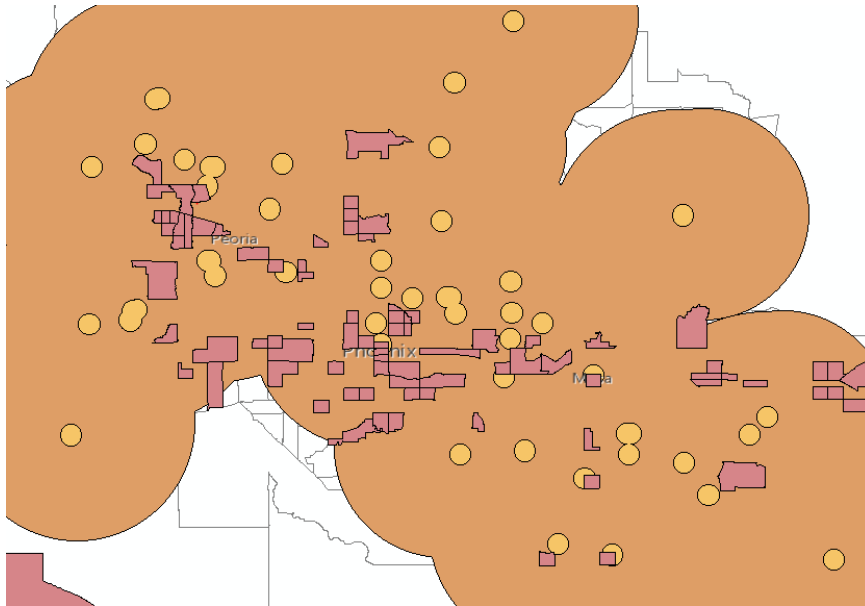


Figure 5. Proximities from Farmers Markets in the Phoenix Metropolitan Area. *The map shows the census tracts (outlined in black) within the Phoenix metropolitan area. The red tract areas are food deserts while the white areas are not. The yellow dots show the 1-mile radius from each farmers market, and the orange dots show the 10-mile radius from each farmers market. The overall map of the state of Arizona shows that 17 farmers markets were within a 1-mile radius and 44 farmers markets were within a 10-mile radius of at least one food desert. This allows for understanding of the usefulness of currently established farmers markets in providing fresh food to surrounding food deserts.*

However, the food access also takes into account the affordability of the food, and so we must take into account those farmers markets that allow those with a low household income to

purchase produce using food stamps through the Supplemental Nutrition Assistance Program (SNAP). In Figure 3, I identified on the map the 12 farmers markets that were SNAP certified out of the 47 farmers markets mapped. As can be seen in Figure 6, of these 12 farmers markets, only 4 were within 1 mile of a food desert, but 11 were within 10 miles of a food desert. Overall, of the 47 farmers markets mapped, only 4 were accessible for a low-income urban community and SNAP certified.

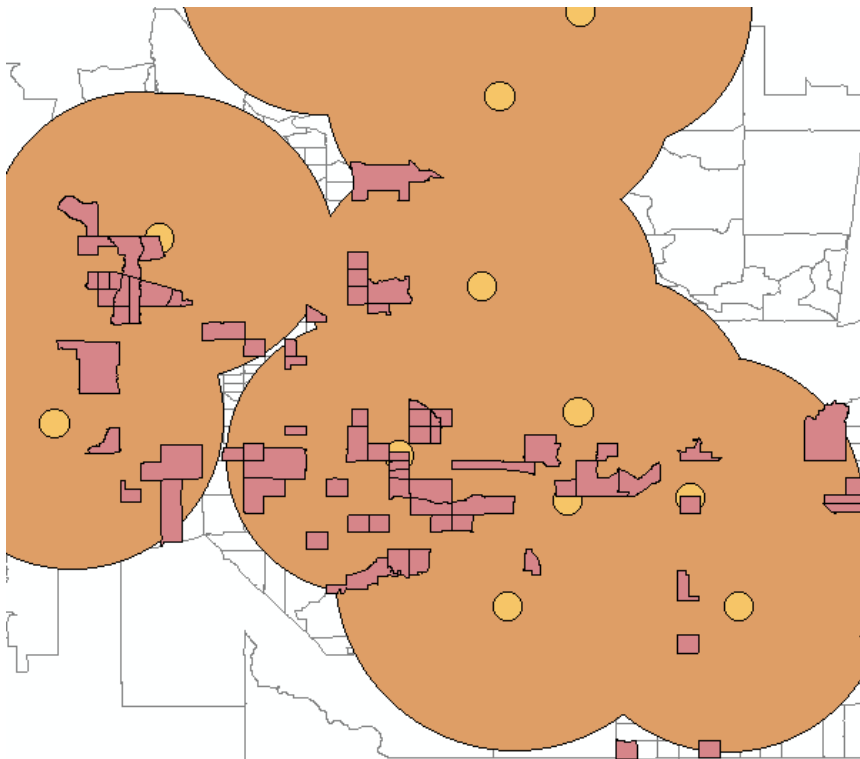


Figure 6. Proximities from SNAP Approved Farmers Markets in the Phoenix Metropolitan Area. *The map shows the census tracts (outlined in black) within the Phoenix metropolitan area. The red tract areas are food deserts while the white areas are not. The yellow dots show the 1-mile radius from each SNAP approved farmers market, and the orange dots show the 10-mile*

radius from each SNAP approved farmers market. The overall map of the state of Arizona shows that 4 of these farmers markets were within a 1-mile radius and 11 of these farmers markets were within a 10-mile radius of at least one food desert. This allows for understanding of the usefulness of currently established SNAP approved farmers markets in providing fresh food to surrounding food deserts. Only 4 of these markets are considered accessible for those in urban food deserts.

As shown in Figure 7, of the 37 food hub and food hub distribution points mapped, 19 were within 1 mile (light orange circles) of a food desert and 34 were within 10 miles (dark orange circles) of at least one food desert. As there are already distribution sites within the food deserts, it may be possible to use these sites to provide food to local communities without much transportation. As the Phoenix metropolitan area, which is the main area covered in the map, is largely urban; the majority of food hubs could not be defined as accessible for urban communities (i.e., within 1 mile from the community, using food access parameters as described within the definition of a food desert). However, their presence and ability to distribute beyond their physical buildings provides a possibility of expansion of current established food hubs to provide better food access to those within food deserts.

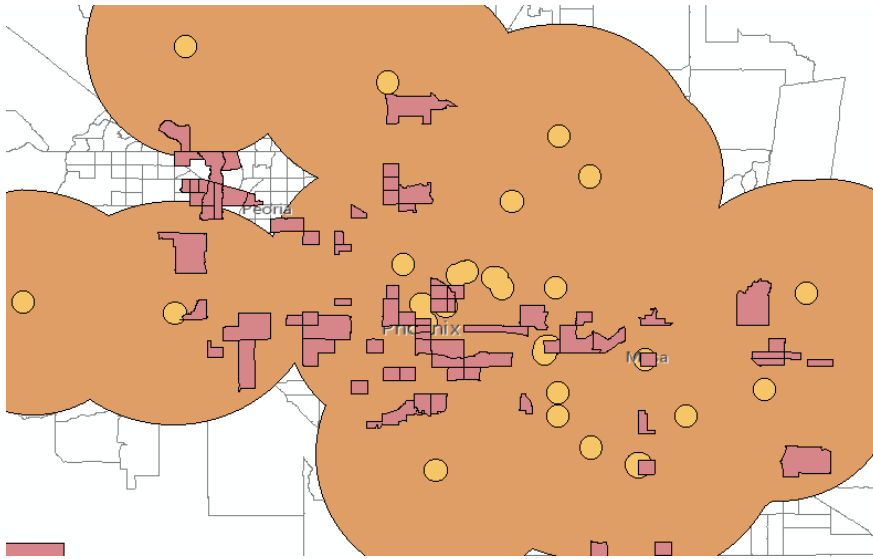


Figure 7. Proximities from Food Hubs in the Phoenix Metropolitan Area. *The map shows the census tracts (outlined in black) within the Phoenix metropolitan area. The red tract areas are food deserts while the white areas are not. The yellow dots show the 1-mile radius from each food hub, and the orange dots show the 10-mile radius from each food hub. The overall map of the state of Arizona shows that 19 food hubs were within a 1-mile radius and 34 food hubs were within a 10-mile radius of at least one food desert. This allows for understanding of the usefulness of currently established food hubs in providing fresh food to surrounding food deserts.*

Also, there may be distributions beyond that which is shown in Figures 4 and 7 above, possibly making food hubs more accessible to those people in food deserts. Given the lack of information regarding the customer base of food hubs and the prices for services, it is not possible to tell whether these food hubs provide to those within food deserts now or whether they would be feasible options in the future. More so, even if many of the locations of present customers are

within the food deserts, as the socioeconomic status and relative health of each individual is not known, there can be no overarching interpretation of the customer base. It is important to note that there can be diversity of these factors (i.e., socioeconomic status, relative health of each individual) within regions classified as food deserts, and that not everyone within them need have a low income and adverse health outcomes. Additionally, we must take into account the fact that including low-income neighborhoods, such as food deserts, may have an effect on the success of a farmers market or food hub; also, distributing in food deserts may come with obstacles.

Research suggests that the success of a farmers market in a low-income community depends on the diversity of products offered, and that they are found to be much more successful when they adopt a flexible system of governance which allows for this product and vendor diversity to exist and be ever-changing.¹⁰⁶ Also, it has been found that farmers and vendors at these markets tend to have an overall positive attitude regarding government-funded nutritional programs that supplement household income to buy food, especially when these programs are “simple and convenient,” as with the Electronic Benefits Transfer (EBT) programs, which allows customers receiving governmental monetary aids for food purchases to use a card that can act as a credit card to use those aids.¹⁰⁷

¹⁰⁶ Montri, D. N. (2012). Sustaining farmers markets in low-income, urban areas: Exploring farmer participation and market development (Order No. 3548775). Available from ProQuest Dissertations & Theses Global. (1282407600). Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1282407600?accountid=4485>

¹⁰⁷ Montri, D. N. (2012). Sustaining farmers markets in low-income, urban areas: Exploring farmer participation and market development (Order No. 3548775). Available from ProQuest Dissertations & Theses Global. (1282407600).

This has been successful in other areas of the country. However, when pertaining to the Phoenix metropolitan area, farmers markets with SNAP programs tend to not be accessible to those within food deserts. In fact of the 17 farmers markets within a 1-mile radius of food deserts in the Phoenix metropolitan area, only 4 were accessible for a low-income urban community and SNAP certified. Actually, it is quite common throughout the country that there is limited access to farmers markets for those in food deserts; so much so that some researchers find that it is difficult to ascertain the effect of farmers markets on food deserts as the circumstance does not occur often enough.¹⁰⁸ Although, seeing as there is a general positive feeling about these EBT and SNAP programs in farmers markets, greater adaption and certification, as well as, increasing ease of use by customers and vendors, could potentially increase the use of farmers markets within these food desert communities.

As for food hubs, a similar problem exists, but on a broader scale: there is little known about the effect of food hubs in general.¹⁰⁹ Their role in the overall food supply system, their methods of governance, the prominent reasons for their establishment, and their impact on the local community are all relatively unknown factors that would be useful in understanding, especially as they pertain to food deserts and other low-income neighborhoods. However, there is some

Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1282407600?accountid=4485>

¹⁰⁸ Brady, A. (2013). Farmers Markets, Low Income Communities And Government Assistance Programs.

¹⁰⁹ Matson, J., & Thayer, J. (2013). The role of food hubs in food supply chains. *Journal of Agriculture, Food Systems, and Community Development*, 3(4), 43-47.

research to suggest that the governance and development of a food hub is largely influenced by its consumers and surrounding constituency.¹¹⁰ As such, it may be possible for both the structure and distribution of a food hub to be influenced by the surrounding community. In the Phoenix metropolitan area, 19 of the 37 food hubs within the area were within a 1-mile radius of a food desert, allowing for the possibility that these organizations will attempt to cater to the needs of those low-income communities around them. However, as more remains to be known about the effects of food hubs on the increase or decrease in access to fresh local food, the evolution of their structures and goals remains to be seen.

Where they currently stand, food hubs and farmers markets are not good sources of fresh produce for food deserts in the state of Arizona. Considering farmers markets, only 4 of 47 identified farmers markets in the state are determined to be accessible to urban food desert communities, i.e., they are SNAP approved and within a 1-mile radius of an urban food desert. Considering food hubs, only 19 of 37 identified locations were geographically accessible to urban food desert communities, i.e., they are within a 1-mile radius of an urban food desert, but there was no evidence to support that any of these location were financially accessible to the same population, i.e., SNAP approved. However, after reviewing various literature surrounding

¹¹⁰ Hamilton, J. M. (2015). Food Hub Decision-Making and Development (Doctoral dissertation, TUFTS UNIVERSITY).

the perceived successes of farmers markets^{111,112,113} around the country, and considering the potential for food hubs to increase their reach¹¹⁴ through changes in distribution networks, I believe that both have the potential to be of use in increasing access to fresh produce in Arizona food deserts.

Future Research

Future research may aim to interview the operators of food hubs and farmers markets to gain more information for analysis. These interviews could aid in understanding the ideologies behind the establishment of these organizations, as well as that of the operators of these food hubs and farmers markets; their understanding of food deserts; the importance they place on food deserts; any potential challenges in providing to food deserts; and the reasoning for their current distribution networks or sites. Additionally, a more detailed network of distribution could be created for analysis in order to determine the extent to which the food hub does/does not reach food deserts by comparing overlaying the asset map of food deserts and the asset map of the food hub's location as well as distribution. In order not to expose the specific locations of customers'

¹¹¹ This farmers market is located in a food desert where there is a low household income. Farmers market counters white earth 'food desert'. (2013, Aug 30). Native American Times Retrieved from

<http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/1433943147?accountid=4485>

¹¹² This farmers market is located in a neighborhood where there is a very high household income. Scarsdale Farmers Market - LocalHarvest. (n.d.). Retrieved April 8, 2015, from <http://www.localharvest.org/scarsdale-farmers-market-M30246>

¹¹³ Scarsdale, New York has a median household income of \$232,422. (n.d.). Retrieved April 8, 2015, from http://www.bestplaces.net/economy/city/new_york/scarsdale

¹¹⁴ Borst, A. (2010). Cooperative food hubs. *Rural Cooperatives*, 77(6), 20-23. Retrieved from <http://login.ezproxy1.lib.asu.edu/login?url=http://search.proquest.com/docview/822743010?accountid=4485>

home addresses, a “catchment area,” which is the extent of the region wherein some asset(s) of interest is/are located¹¹⁵, could be used; here, the assets would be distribution sites.

Additionally, further research could allow for a deeper understanding of food deserts, themselves, and the diversity that may exist within them. For example, overlaying socioeconomic data and health outcome (e.g., life span, heart disease, cancer, obesity) statistics gathered from state census data and the Centers for Disease Control and Prevention (CDC)’s records, respectively, could allow for an understanding of the diversity of food deserts within themselves and when compared to each other. These factors may shed light on the differences between and within food deserts, with respect to socioeconomic conditions, health, and proximity to food hubs and farmers markets, and allow for further analysis of the effects of proximity to food hubs, proximity to farmers markets, and socioeconomic status on health within and between communities. Such analysis could potentially lead to an understanding of the importance of food hubs and farmers markets, and how to maximize their use in improving food access to food deserts. However, systems and methods must also be established to deal with the complex nature of the information available, such as with organizing, accessing, and analyzing large amounts of aggregate data.

¹¹⁵ Cacciari, M., Salam, G. P., & Soyez, G. (2008). The catchment area of jets. *Journal of High Energy Physics*, 2008(04), 005.

CHAPTER 5

CONCLUSION

Based on the spatial analysis done through the use of asset mapping on ArcGIS, I believe there is great promise in using both food hubs and farmers markets in increasing food access in food deserts. I believe that this can be done through two basic steps. First, the food hubs and farmers markets need to become more spatially accessible to food deserts throughout the state. This would require food hub distribution centers and farmers market locations to be established throughout the state, so that these resources exist outside of the metropolitan Phoenix area. Second, the price of produce sold should be within a price range such that members of food deserts are able to make purchases. This can be done through many means, such as the programs becoming SNAP-certified, but these measures must be careful not to create a lack of diversity in the produce offered, and should not negatively affect the sellers.

Overall, although food hubs and farmers markets may not be viable sources for fresh produce as they are currently, there could be changes made to make them more accessible. Food hubs and farmers markets will not be the solution to food insecurity in food deserts, but understanding their structures and the ways in which they can be implemented could allow for greater food access in those regions. Further research is required to analyze the specific ways in which food hubs and farmers markets are operated now, and any barriers that may exist in trying to use them to increase food access.

APPENDIX

Table 1. List of Food Deserts in Arizona

CensusTract	County	Food Desert Classification
04001942600	Apache	Rural Food Desert
04001942700	Apache	Rural Food Desert
04001944000	Apache	Rural Food Desert
04001944100	Apache	Rural Food Desert
04001944300	Apache	Rural Food Desert
04001944901	Apache	Rural Food Desert
04001944902	Apache	Rural Food Desert
04001945002	Apache	Rural Food Desert
04001945100	Apache	Rural Food Desert
04003000100	Cochise	Rural Food Desert
04003000203	Cochise	Rural Food Desert
04003000400	Cochise	Rural Food Desert
04005942201	Coconino	Rural Food Desert
04005942202	Coconino	Rural Food Desert
04005945000	Coconino	Rural Food Desert
04005945100	Coconino	Rural Food Desert
04007000100	Gila	Rural Food Desert
04007000600	Gila	Rural Food Desert
04007000800	Gila	Rural Food Desert
04009940500	Graham	Rural Food Desert
04011960300	Greenlee	Rural Food Desert
04012020202	La Paz	Rural Food Desert
04012020501	La Paz	Rural Food Desert
04012020502	La Paz	Rural Food Desert
04012940300	La Paz	Rural Food Desert
04013050604	Maricopa	Rural Food Desert
04013723306	Maricopa	Rural Food Desert
04013940700	Maricopa	Rural Food Desert
04015950100	Mohave	Rural Food Desert
04015950401	Mohave	Rural Food Desert
04015950600	Mohave	Rural Food Desert
04015954800	Mohave	Rural Food Desert
04017940008	Navajo	Rural Food Desert

04017940010	Navajo	Rural Food Desert
04017940011	Navajo	Rural Food Desert
04017940013	Navajo	Rural Food Desert
04017940014	Navajo	Rural Food Desert
04017940015	Navajo	Rural Food Desert
04017940100	Navajo	Rural Food Desert
04017942300	Navajo	Rural Food Desert
04017942400	Navajo	Rural Food Desert
04017960500	Navajo	Rural Food Desert
04017964202	Navajo	Rural Food Desert
04019004313	Pima	Rural Food Desert
04019940600	Pima	Rural Food Desert
04019940700	Pima	Rural Food Desert
04019940800	Pima	Rural Food Desert
04021002200	Pinal	Rural Food Desert
04021941400	Pinal	Rural Food Desert
04025001401	Yavapai	Rural Food Desert
04025001402	Yavapai	Rural Food Desert
04025001403	Yavapai	Rural Food Desert
04025001500	Yavapai	Rural Food Desert
04025002100	Yavapai	Rural Food Desert
04027010914	Yuma	Rural Food Desert
04027012100	Yuma	Rural Food Desert
04003000202	Cochise	Urban Food Desert
04003000301	Cochise	Urban Food Desert
04003000700	Cochise	Urban Food Desert
04003000800	Cochise	Urban Food Desert
04003001000	Cochise	Urban Food Desert
04003001100	Cochise	Urban Food Desert
04003001401	Cochise	Urban Food Desert
04003001502	Cochise	Urban Food Desert
04003001702	Cochise	Urban Food Desert
04005000500	Coconino	Urban Food Desert
04005001700	Coconino	Urban Food Desert
04005944900	Coconino	Urban Food Desert
04005945200	Coconino	Urban Food Desert
04007000200	Gila	Urban Food Desert

04007000900	Gila	Urban Food Desert
04007001000	Gila	Urban Food Desert
04013040502	Maricopa	Urban Food Desert
04013040506	Maricopa	Urban Food Desert
04013050701	Maricopa	Urban Food Desert
04013050702	Maricopa	Urban Food Desert
04013060801	Maricopa	Urban Food Desert
04013060903	Maricopa	Urban Food Desert
04013060904	Maricopa	Urban Food Desert
04013061011	Maricopa	Urban Food Desert
04013061041	Maricopa	Urban Food Desert
04013061042	Maricopa	Urban Food Desert
04013071504	Maricopa	Urban Food Desert
04013071505	Maricopa	Urban Food Desert
04013071600	Maricopa	Urban Food Desert
04013071701	Maricopa	Urban Food Desert
04013071702	Maricopa	Urban Food Desert
04013071801	Maricopa	Urban Food Desert
04013071912	Maricopa	Urban Food Desert
04013082022	Maricopa	Urban Food Desert
04013082204	Maricopa	Urban Food Desert
04013082210	Maricopa	Urban Food Desert
04013083000	Maricopa	Urban Food Desert
04013092401	Maricopa	Urban Food Desert
04013092600	Maricopa	Urban Food Desert
04013093001	Maricopa	Urban Food Desert
04013093200	Maricopa	Urban Food Desert
04013103609	Maricopa	Urban Food Desert
04013103615	Maricopa	Urban Food Desert
04013103900	Maricopa	Urban Food Desert
04013104206	Maricopa	Urban Food Desert
04013104401	Maricopa	Urban Food Desert
04013104502	Maricopa	Urban Food Desert
04013108601	Maricopa	Urban Food Desert
04013110600	Maricopa	Urban Food Desert
04013110701	Maricopa	Urban Food Desert
04013110702	Maricopa	Urban Food Desert

04013111204	Maricopa	Urban Food Desert
04013111602	Maricopa	Urban Food Desert
04013111700	Maricopa	Urban Food Desert
04013112302	Maricopa	Urban Food Desert
04013112505	Maricopa	Urban Food Desert
04013112508	Maricopa	Urban Food Desert
04013112512	Maricopa	Urban Food Desert
04013112513	Maricopa	Urban Food Desert
04013112900	Maricopa	Urban Food Desert
04013113100	Maricopa	Urban Food Desert
04013113801	Maricopa	Urban Food Desert
04013114100	Maricopa	Urban Food Desert
04013114200	Maricopa	Urban Food Desert
04013114703	Maricopa	Urban Food Desert
04013114900	Maricopa	Urban Food Desert
04013115200	Maricopa	Urban Food Desert
04013115300	Maricopa	Urban Food Desert
04013115600	Maricopa	Urban Food Desert
04013115700	Maricopa	Urban Food Desert
04013116000	Maricopa	Urban Food Desert
04013116100	Maricopa	Urban Food Desert
04013116606	Maricopa	Urban Food Desert
04013116702	Maricopa	Urban Food Desert
04013116703	Maricopa	Urban Food Desert
04013116732	Maricopa	Urban Food Desert
04013116800	Maricopa	Urban Food Desert
04013117000	Maricopa	Urban Food Desert
04013117200	Maricopa	Urban Food Desert
04013218300	Maricopa	Urban Food Desert
04013318400	Maricopa	Urban Food Desert
04013318700	Maricopa	Urban Food Desert
04013320002	Maricopa	Urban Food Desert
04013420113	Maricopa	Urban Food Desert
04013420202	Maricopa	Urban Food Desert
04013420206	Maricopa	Urban Food Desert
04013420214	Maricopa	Urban Food Desert
04013420401	Maricopa	Urban Food Desert

04013421201	Maricopa	Urban Food Desert
04013421400	Maricopa	Urban Food Desert
04013422304	Maricopa	Urban Food Desert
04013422625	Maricopa	Urban Food Desert
04013422627	Maricopa	Urban Food Desert
04013522800	Maricopa	Urban Food Desert
04013523102	Maricopa	Urban Food Desert
04013614700	Maricopa	Urban Food Desert
04013813800	Maricopa	Urban Food Desert
04013817400	Maricopa	Urban Food Desert
04015950703	Mohave	Urban Food Desert
04015950705	Mohave	Urban Food Desert
04015950706	Mohave	Urban Food Desert
04015951501	Mohave	Urban Food Desert
04015951602	Mohave	Urban Food Desert
04015951700	Mohave	Urban Food Desert
04015951800	Mohave	Urban Food Desert
04015951900	Mohave	Urban Food Desert
04015952001	Mohave	Urban Food Desert
04015952004	Mohave	Urban Food Desert
04015952900	Mohave	Urban Food Desert
04015953000	Mohave	Urban Food Desert
04015953602	Mohave	Urban Food Desert
04015954900	Mohave	Urban Food Desert
04017940301	Navajo	Urban Food Desert
04017942500	Navajo	Urban Food Desert
04019000100	Pima	Urban Food Desert
04019000400	Pima	Urban Food Desert
04019000500	Pima	Urban Food Desert
04019002100	Pima	Urban Food Desert
04019002501	Pima	Urban Food Desert
04019002503	Pima	Urban Food Desert
04019002505	Pima	Urban Food Desert
04019003702	Pima	Urban Food Desert
04019003705	Pima	Urban Food Desert
04019003707	Pima	Urban Food Desert
04019004011	Pima	Urban Food Desert

04019004035	Pima	Urban Food Desert
04019004114	Pima	Urban Food Desert
04019004116	Pima	Urban Food Desert
04019004122	Pima	Urban Food Desert
04019004307	Pima	Urban Food Desert
04019004317	Pima	Urban Food Desert
04019004320	Pima	Urban Food Desert
04019004407	Pima	Urban Food Desert
04019004411	Pima	Urban Food Desert
04019004419	Pima	Urban Food Desert
04019004430	Pima	Urban Food Desert
04019004504	Pima	Urban Food Desert
04019004506	Pima	Urban Food Desert
04019470400	Pima	Urban Food Desert
04019941000	Pima	Urban Food Desert
04021000308	Pinal	Urban Food Desert
04021000309	Pinal	Urban Food Desert
04021000310	Pinal	Urban Food Desert
04021000313	Pinal	Urban Food Desert
04021000314	Pinal	Urban Food Desert
04021000318	Pinal	Urban Food Desert
04021000400	Pinal	Urban Food Desert
04021000901	Pinal	Urban Food Desert
04021000902	Pinal	Urban Food Desert
04021001000	Pinal	Urban Food Desert
04021001305	Pinal	Urban Food Desert
04021001306	Pinal	Urban Food Desert
04021001500	Pinal	Urban Food Desert
04021001708	Pinal	Urban Food Desert
04021001710	Pinal	Urban Food Desert
04021002003	Pinal	Urban Food Desert
04023966103	Santa Cruz	Urban Food Desert
04023966105	Santa Cruz	Urban Food Desert
04023966200	Santa Cruz	Urban Food Desert
04023966301	Santa Cruz	Urban Food Desert
04023966401	Santa Cruz	Urban Food Desert

04025000605	Yavapai	Urban Food Desert
04025000606	Yavapai	Urban Food Desert
04025000608	Yavapai	Urban Food Desert
04025000609	Yavapai	Urban Food Desert
04025002001	Yavapai	Urban Food Desert
04025002002	Yavapai	Urban Food Desert
04025002003	Yavapai	Urban Food Desert
04027000301	Yuma	Urban Food Desert
04027000402	Yuma	Urban Food Desert
04027000404	Yuma	Urban Food Desert
04027000903	Yuma	Urban Food Desert
04027010905	Yuma	Urban Food Desert
04027010910	Yuma	Urban Food Desert
04027011104	Yuma	Urban Food Desert
04027011111	Yuma	Urban Food Desert
04027011114	Yuma	Urban Food Desert
04027011405	Yuma	Urban Food Desert
04027011406	Yuma	Urban Food Desert
04027011700	Yuma	Urban Food Desert

Table 2. List of Farmers Markets in Arizona

Farmers Market	Address	City	State	Zip	Accept SNAP?
Anthem Farmers Market	41703 N. Gavilan Peak Pkwy.	Anthem	AZ	85086	Yes
Carefree Farmers Market	100 Easy St.	Carefree	AZ	85377	Yes
Tatum Ranch Farmers Market	29660 N. Tatum Blvd.	Cave Creek	AZ	85331	Yes
Chandler Farmers Market	3 S. Arizona Avenue	Chandler	AZ	85225	No
Sunbird Market	6240 E. Sunbird Blvd.	Chandler	AZ	85249	No
Fountain Hills Farmers Market	16858 E. Ave. of the Fountains	Fountain Hills	AZ	85268	No
Agritopia Farm Stand	3000 E. Ray Road	Gilbert	AZ	85296	No
Gilbert Farmers Market	222 N. Ash St.	Gilbert	AZ	85234	No
Gilbert Town Square Twilight Market	1040 S. Gilbert Rd.	Gilbert	AZ	85296	Yes
Ray's Market - The Barn at Power Ranch	3685 E. Autumn Drive	Gilbert	AZ	85297	No
Stock Shop Farmer's Market	6615 W. Thunderbird Rd.	Glendale	AZ	85306	No
Westgate Market at the 101	6770 N. Sunset Blvd.	Glendale	AZ	85305	No
Twilight Farmers' Market at the Citadelle Plaza	19420 N 59th Avenue	Glendale	AZ	85308	
Downtown Glendale Farmers' Market	5734 W. Glendale Ave	Glendale	AZ	85301	
Estrella Lakeside Market	10300 S Estrella Pkwy.	Goodyear	AZ	85338	No
Pebble Creek Farmers' Market at Tucscany Falls	16222 Clubhouse Dr.	Goodyear	AZ	85395	
Goodyear Farmers Market	3151 N. Litchfield Rd.	Goodyear	AZ	85395	Yes
Wigwam Farmers Market	300 E. Wigwam Blvd.	Litchfield Park	AZ	85340	No
Mesa Community Market	263 N. Center St.	Mesa	AZ	85201	Yes
Ray's Market - Augusta Ranch	2401 S. Lansing	Mesa	AZ	85209	No
Super Farm Market	3440 S. Hawes Road	Mesa	AZ	85212	No
Momma's Organics	9744 W. Northern Ave.	Peoria	AZ	85345	No
Trilogy at Vistancia	27980 N. Trilogy Blvd.	Peoria	AZ	85383	No
Vistancia Peoria Market	12902 W. Yellow Bird Ln.	Peoria	AZ	85383	No
Westbrook Village Peoria FM	19251 N. Westbrook Parkway	Peoria	AZ	85382	No
Ahwatukee Farmers Market	4700 E. Warner	Phoenix	AZ	85044	Yes
Arcadia Farmers Market	3811 N. 44th St.	Phoenix	AZ	85018	No
Central Farmers Market	7901 N. Central Ave.	Phoenix	AZ	85020	No
Desert Ridge Farmers Market	3535 E. Mayo Blvd.	Phoenix	AZ	85050	No
Phoenix Public Market	721 N. Central Ave.	Phoenix	AZ	85004	Yes
Roadrunner Farmers Market	3502 E. Cactus Rd.	Phoenix	AZ	85032	Yes
St. Joseph's Hospital Farmers Market	350 W. Thomas Rd.	Phoenix	AZ	85013	No
The Camelback Market	3930 E. Camelback Rd.	Phoenix	AZ	85018	No

Town and Country Farmers Market	2021 E. Camelback Rd.	Phoenix	AZ	85016	No
Uptown Farmers' Market	5757 N. Central Ave.	Phoenix	AZ	85012	No
Encanterra Farmers Market	36460 N. Encanterra Dr	San Tan Valley	AZ	85140	No
Skysong Farmers Market	1475 N. Scottsdale Rd.	Scottsdale	AZ	85257	
Borgata of Scottsdale European Market	6166 N. Scottsdale Rd	Scottsdale	AZ	85253	
Old Town Farmers Market	3815 N Brown Ave	Scottsdale	AZ	85251	Yes
Singh Farms Farmers Market	8900 E. Thomas Rd.	Scottsdale	AZ	85256	No
Linden Tree Nursery Market	11150 W. Beardsley Rd.	Sun City	AZ	85373	No
Sun City Farmers Market	16820 North 99th Avenue	Sun City	AZ	85351	Yes
Corte Bella Farmers Market	22135 N. Mission Dr.	Sun City West	AZ	85375	No
IronOaks at Sun Lake Market	24218 S. Oakwood Boulevard	Sun Lakes	AZ	85248	No
Sun City Grande Farmers Market	19726 North Remington Drive	Surprise	AZ	85374	No
ASU Farmers Market	300 E. Orange Mall	Tempe	AZ	85287	Yes
Ray's Market - McClintock Fountains	1840 E. Warner Rd.	Tempe	AZ	85284	No

Table 3. List of Food Hubs in Arizona

Food Hub	Address	City	State	Zip
44 Monroe	44 West Monroe Street	Phoenix	Arizona	85003
Alis Living formally JAM location	6938 East 1st Street	Scottsdale	Arizona	85251
Anthem Area	4434 West Moss Springs Road	Anthem	Arizona	85086
Arcadia Farmers Markets	3811 North 44th Street	Phoenix	Arizona	85018
Axosoft	13835 North Northsight Boulevard #205	Scottsdale	Arizona	85018
Chandler Farmers Market	3 South Arizona Avenue	Chandler	Arizona	85225
Downtown Phoenix Public Market	14 E Pierce St, Phoenix	Phoenix	Arizona	85004
Edward Jones	1650 North Dysart Road, Suite 3	Goodyear	Arizona	85395
Elevate Coffee	2530 W Happy Valley Road #1273	Phoenix	Arizona	85085
Gangplank Chandler	260 S Arizona Ave	Chandler	Arizona	85225
Gilbert Farmers Market	222 N Ash St	Gilbert	Arizona	85234
Hayden Flour Mills, LLC	119 South Mill Avenue	Tempe	Arizona	85281
Iskashitaa	1406 East Grant Road	Tucson	Arizona	85719
Las Sendas Trailhead	7900 E. Eagle Crest Drive	Mesa	Arizona	85207
Lo Fi Coffee	105 West Main Street	Mesa	Arizona	85201
MMPR Marketing	3939 East Campbell Avenue, Suite 120	Phoenix	Arizona	85018
Open Air Market at the Phoenix Public Market	721 North Central Avenue	Phoenix	Arizona	85004
Shine Coffee Midtown Phoenix	10 West Vernon Avenue	Phoenix	Arizona	85003
Tempe Farmers Friday Market (Grocery Store)	805 S Farmer Ave	Tempe	Arizona	85281
Tempe Farmers Sunday Market (Grocery Store)	805 S Farmer Ave	Tempe	Arizona	85281
The Esplanade	2415 E Camelback Road	Phoenix	Arizona	85016
The Hive & Bees Knees	2222 N. 16th Street	Phoenix	Arizona	85006
Verrado Coffee Company	829 N Verrado Way	Buckeye	Arizona	85396
Vistancia Community	29701 N Sunrise Point	Peoria	Arizona	85383
Whole Foods - Camelback	4701 N. 20th Street	Phoenix	Arizona	85016
Whole Foods - Chandler	2955 West Ray Road	Chandler	Arizona	85224
Whole Foods - Paradise Valley	10810 N Tatum Blvd	Phoenix	Arizona	85028
Whole Foods - Scottsdale	7111 E. Mayo Blvd	Scottsdale	Arizona	85054
Whole Foods - Tempe	5120 S. Rural Rd	Tempe	Arizona	85282
YCGrown		Chino Valley	Arizona	86323
YMCA Ahwatukee	1030 E Liberty Ln	Phoenix	Arizona	85048
YMCA Chris-Town	5517 N. 17th Avenue	Phoenix	Arizona	85015
YMCA Downtown	350 N. 1st Avenue	Phoenix	Arizona	85003
YMCA Ross Farnsworth Mesa	1807 S. Sunview	Mesa	Arizona	85206
YMCA Tempe	7070 S. Rural Road	Tempe	Arizona	85283
Yuma Organic		Yuma	Arizona	

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